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TITLE: COMPUTER GENERATED MOVIES TO DISPLAY BIOTELEMETRY DATA

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COMPUTER GENERATED MOVIES TO DISPLAY BIOTELEMETRY DATA

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ABSTRACT

The three dimensional nature of biotelemetry data (x, y, time) make them difficult to comprehend. Graphic displays provide a means of extracting information and analyzing biotelemetry data. The extensive computer graphics facilities at Los Alamos Scientific Laboratory have been utilized to analyze elk biotelemetry data. Fixes have been taken weekly for 14 months on 14 animals. The inadequacy of still graphic displays to portray the time dimension of this data has lead to the use of computer generated movies to help grasp time relationships. A computer movie of the data from one animal demonstrates habitat use as a function of time, while a movie of 2 or more animals illustrates the correlations between the animal's movements. About 2 hours of computer time were required to generate the movies for each animal for 1 year of data. The cost of the movies is quite small relative to the cost of collecting the data, so that computer generated movies are a reasonable method to depict biotelemetry data.

INTRODUCTION

The typical biotelemetry study generally results in a large amount of data that is difficult to interpret and display because of a lack of effective presentation methods. Biotelemetry data are actually three dimensional: x and y coordinates and time. Thus three dimensional methods of viewing the data would generally facilitate interpretation because any method of collapsing three dimensions into two results in some loss of information. An example of the problem is illustrated by the elk telemetry data in Fig. 1. The movements of an individual over a 13 month period (weekly observations) are represented two dimensionally by arrow heads (actual observations) connected by lines. Thus beginning at the capture location, the elk's location can be determined as a function of time. However, in attempting to trace the animal's movements on the map, the time dimension is rapidly lost.

I have explored the use of computer generated 16 mm movies to portray biotelemetry data to permit the time dimension of the data to be viewed in the correct evolutionary sequence.

The present version of the movie consists of a colored base map (color combinations are available) with a small square moving within the map to depict

animal movements. The color intensely of the square can be enhanced when location of the animal is based upon an actual radio-location; whereas movement of the square at normal color intensely represents linear interpolation between actual radio fixes.

The time dimension is also displayed on the map. In the present version of the program, the month of the year is displayed simultaneously with the animal movements data obtained during the same time period. However, any time period can easily be represented. A permanent trace of the movements of the animal during an observation period can be obtained to facilitate identification of areas of frequent use and rough home range sizes.

Data from multiple animals can also be displayed simultaneously to examine interactions between individuals, sexes and age classes as a function of season and habitat. Individuals or groups of animals (stratified by age or sex) can be distinguished by color of the squares. Movements of individual animals are not permanently traced because of the clutter that would result.

METHODS

A total of 16 elk were trapped and radio collared between January and May of 1978. These animals are located on a weekly basis (or more often) with a hand held yagi antenna. Locations are plotted on an x-y coordinate system and coded for computer processing.

MAPPER (Dahl 1979), a computer graphics software package recently developed at Los Alamos Scientific Laboratory (LASL), has been used to generate the movies. The MAPPER program provides a simple-to-use tool for making computer generated color slides and publication quality figures such as Fig. 1. Also, MAPPER contains a set of commands essential for making movies. For example the STORE, COPY, and REPEAT commands permit the repetition of graphics on successive movie frames.

A base map for the area traveled by the radio collared elk was entered into the computer in a MAPPER compatible format with a Tektronics Model 4954 Graphics Tablet. The original map utilized for 35 mm slides is shown in black and white in Fig. 1. Much of the detail was eliminated from Fig. 1 to form the basic map used in the movies, because the amount of clutter tended to distract the observer from the movements of the animal.

A FORTRAN program has been written to read the observations of each elk and generate a file of commands to be processed by MAPPER. The FORTRAN program does the actual linear interpolation between radio fixes. However, commands are generated to have MAPPER store the map in the camera memory, and recall it for each frame.

The film is physically generated with an FR-80 film recorder, which operates

off line using magentic tape input. The FR-80 recorder produces high quality black and white (6 gray levels) and color film output in 16 mm and 35 mm, plus black and white 105 mm microfiche. The recorder has high resolution with 16,334 x 16,384 raster points on a cathode-ray tube (CRT). The colored image on the CRT is then photographed.

COSTS

Software development to generate movies for the biotelemetry data was minimal because the MAPPER program already existed. The FORTRAN program to generate MAPPER input was modified to generate multiple 16 mm frames from the original 35 mm slides. These modifications required about 4 man days. Further applications will require less software modification because the major input comes from the data file for the animal locations. Also each application requires a base map to be digitized and stored into the computer in MAPPER compatible format. The software is available to perform this task, and requires about 3 hours for the average simplified map to be entered and edited.

An actual production run of a single animal with weekly fixes for a year requires 3.5 hr. of computer time on a CDC 6600 supporting the Network Operating System. At LASL, the cost is ~$200, but this rate will vary between computer centers. When the cost of collecting the data is considered, the $200 for a movie to display the data is very minor. Production runs for multiple animals on one movie is cheaper (~$150) because no permanent tracing of movements is left.

CONCLUSIONS

Computer generated movies provide a major new approach to the display of biotelemetry data in a form easily comprehended by both professional biologists and lay persons. Relative to the expense of collecting the data, the cost of generating the movie is very minor. The capability to observe the interactions through time between individual animals is one of the major advantages of analyzing biotelemetry data with movies. As the technique becomes more widely used, more sophisticated presentations will no doubt be developed.

ACKNOWLEDGMENTS

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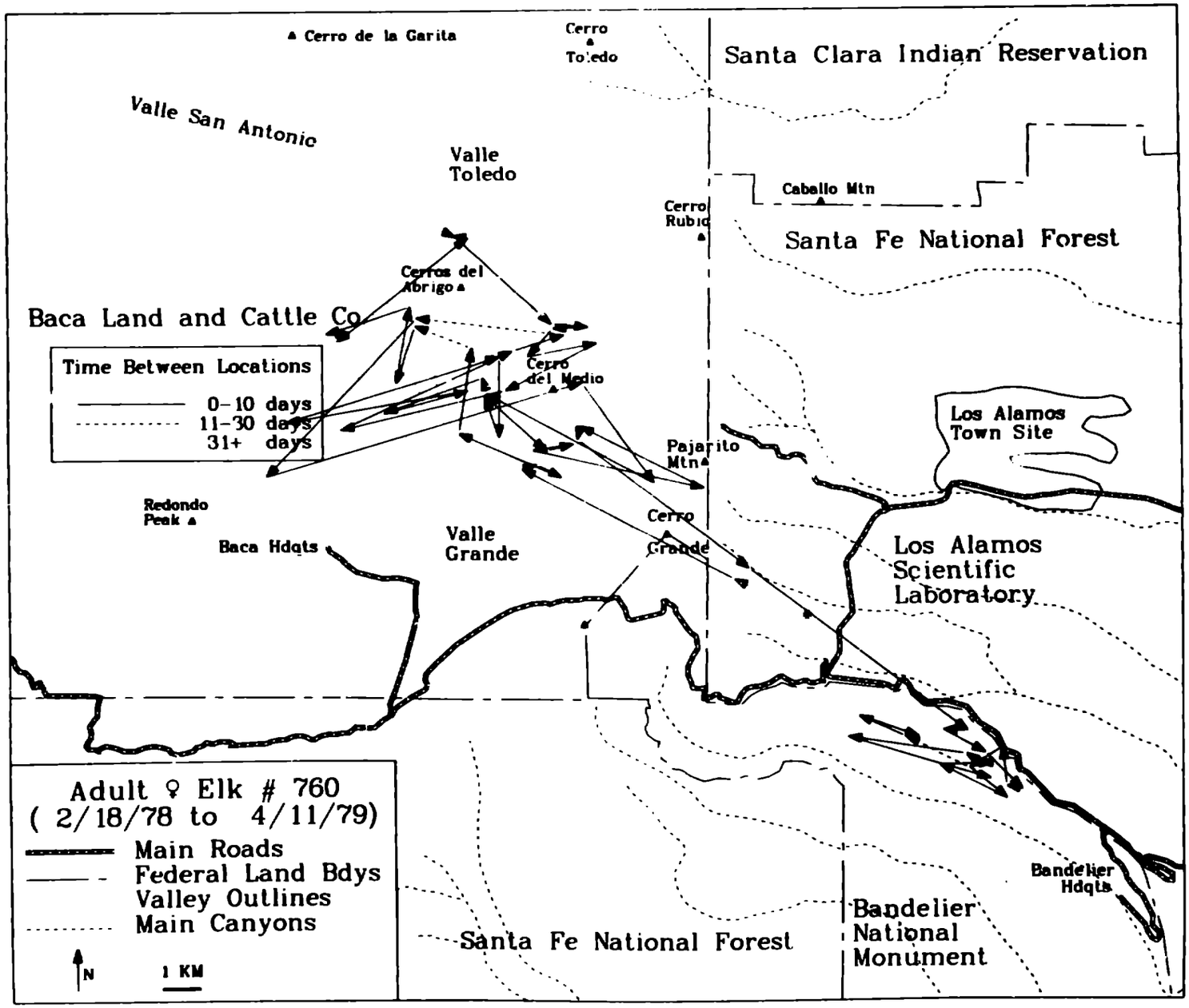
Fig. 1. Computer generated plot of the movements of one animal.


Cerro de la Garita
Cerro Toledo
Santa Clara Indian Reservation
Valle San Antonio
Valle Toledo
Caballo Mtn
Cerro Rubio
Santa Fe National Forest
Cerros del Abrigo
Baca Land and Cattle Co
Time Between Locations
0-10 days
11-30 days
31+ days
Cerro del Medio
Los Alamos Town Site
Pajarito Mtn
Redondo Peak
Baca Hdqts
Valle Grande
Cerro Grande
Los Alamos Scientific Laboratory
Adult ♀ Elk # 760
(2/18/78 to 4/11/79)
Main Roads
Federal Land Bdys
Valley Outlines
Main Canyons
N
1 KM
Santa Fe National Forest
Bandelier Hdqts
Bandelier National Monument

LITERATURE CITED

Dahl, D. A. 1979. MAPPER. Los Alamos Scientific Laboratory Program Library Write-up, J5AJ. 111 p.